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SOME NOTES ON EMPYEMATA IN CHILDHOOD.

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I HAVE considered as empyemata all cases where pus was found in the pleural cavity, either before or after death, so that in this series of 50 cases, 4 cases are included where loculated collections of pus were only discovered on post-mortem examination; 3 cases where the presence of pus was shewn by the exploring needle, but where no further operative interference was required; and 3 cases where the patient was admitted moribund, and died within 24 hours. Of the 14 cases which died 7 were not operated upon.

With regard to the terms used in the following pages, *Dismissed well* means that the patient left hospital with apparently a normal lung and in good general health; *Dismissed improved* implies that the general health was good, while some local condition [dulness, retraction of chest, impaired R.M., etc.] still obtained. Failure in the general health, continued pyrexia, etc., is always *Dismissed worse.*

The bulk of the cases occurred in the wards of the Royal Hospital for Sick Children, and I am indebted to the Staff for their permission to make use of them.

ALL CASES—

TABLE I.

	AGE—Under 2½	5	7½	10	12½ years.	Total.
Dismissed well, -	3	8	9	1	1	22
Dismissed improved,	2	2	3	3	1	11
Dismissed worse, -	1	2	–	–	–	3
Death, - - -	8	6	–	–	–	14
	14	18	12	4	2	50

OPERATION CASES ONLY—

AGE—Under	2½	5	7½	10	12½ years.	Total.
Dismissed well,	3	7	9	1	1	21
Dismissed improved,	2	2	2	2	1	9
Dismissed worse,	1	2	–	–	–	3
Death,	3	4	–	–	–	7
	9	15	11	3	2	40

It is very striking that the mortality, as shewn above, is entirely in cases under 5 years of age. The youngest child dismissed well was aged 11 months.

Sex.—28 of these cases were males, and 22 females.

Previous health.—The condition of health prior to the illness is noted in 39 cases. In 19 the children were said to have been healthy and the onset of the illness sudden. In the remaining 20 the children were either said to have been always "delicate," or some antecedent ill health had been recognized; 3 out of the former 19 cases died, and 7 out of the latter 20.

It appears from these figures that in slightly more than half the cases there had been some antecedent ill health. Eustace Smith's remark that, "To have pleurisy it is almost necessary that the subject should be cachectic or ill nourished," is perhaps rather too emphatic.

Rachitis.—This was noted in only 14 cases, and signs were present in 8 of these. Of these 8 rachitic cases 5 died, but only 1 of the 6 non-rachitic ones. A large number of the other cases must have been rachitic, but, unfortunately, there are no notes on this. [Out of 176 consecutive cases treated in the medical wards of the Royal Hospital for Sick Children, 63 or 35·8 per cent. were rachitic.]

Family history.—This is noted in 41 cases. In 31 cases it was good, and in 10 tuberculosis in some form had occurred in near relatives [parents, brothers, sisters, uncles, aunts]. Of these 10 cases, 5 were dismissed well, 1 was dismissed improved, 1 dismissed worse (probably tuberculous), and 2 died. [1 was found to be tuberculous, in the other there was no post-mortem.]

Causation.—The etiology of pleurisy is still disputed. Donkin holds that it is generally secondary—usually to a pneumonia—while Eustace Smith thinks that primary pleurisy is rare in healthy children, but may occur in cachectic or debilitated cases. Ashby and Wright consider that pleurisy may be primary, the result of cold or injury, but that empyemata are "in a vast majority of cases" the result of a pleuro-pneumonia; and Henoch says that tuberculosis and pneumonia (croupous rather than catarrhal) are important factors in causation. In the recent discussion at the British Medical Association meeting at Portsmouth, M'Guire quoted Jenner to the effect that tuberculosis is often the cause of empyema, and with this he himself agreed. Papapanagiotu, in an interesting paper on pleurisy in young infants, considered that, out of 23 cases of pleural effusion, only 2 were primarily pleural (pus, 1; serous fluid, 1).

The bacteriology of pleural effusions has recently been investigated, and it is from this direction that one must expect further light on the subject, all the more so as it seems probable that the causation in adults is different from that in children. The microbes associated with empyema in childhood are (1) the pneumococcus, either alone or mixed with streptococci; (2) a streptococcus or a staphylococcus, either alone or together; and (3) the bacillus tuberculosis.

(1) With regard to the pneumococcus cases, in many instances the pleurisy is either primary, (*i.e.* a lung lesion is entirely absent) or the lung condition, if present, is of so slight a character that it is entirely masked by the pleural. That a primary pleural infection is possible seems *a priori* probable, especially as a pneumococcic acute arthritis has been recorded with no pulmonary infection.[1] Netter[2] found the pneumococcus in pure culture or with a streptococcus in 15 out of 28 empyemata, and Koplik found it in 9 out of 15. The former states that in 53·6 per cent. of cases the pneumococcus is found alone, and in 3·6 per cent. associated with a streptococcus.

(2) In this group Netter found a streptococcus alone in 17·6 per cent. of his cases, and Koplik in 3 out of 15. The latter found a staphylococcus alone in 2 cases.

(3) It is with regard to the frequency of the tuberculous

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[1] Widal and Lesné, *Bull. d. l. Soc. des Hop. de Paris*, 1898, p. 394.

[2] Netter, *Maladies de la Plèvre, Traité de Médecine*, Paris, 1901.

group that opinion differs. Examination of the pus or culture experiments are usually negative, and even inoculation is generally unsatisfactory. Netter gives 14 per cent. as the ratio in childhood. Koplik found 1 in 15.

TABLE II.

I have examined the post-mortem records of the Royal Hospital for Sick Children, and have tabulated a series of cases in which pus in appreciable quantity was found in the pleural cavity. Of these there are 33, some of which are cases whose clinical history has been made use of elsewhere, but, in the majority of cases, the pleural condition must have had little to do with the ultimate result.

No pulmonary consolidation.—In 5 cases there was no lesion in the corresponding lung, but in 1 the other lung shewed evidences of bronchitis: in 1 there was pericarditis as well, and in 1 (a case of Hodgkin's disease) pus was present in the left pleural, the pericardial, and peritoneal cavities.

Pneumonia.—5 were cases of acute pneumonia.

Broncho-pneumonia. Septic broncho-pneumonia.—8 were cases of broncho-pneumonia, and in 2 other cases small abscesses were found in the pulmonary parenchyma, associated with broncho-pneumonia.

Pyæmia.—In 4 cases the empyema was part of a general pyæmia.

Tuberculosis.—In 9 cases the corresponding lung was tuberculous, and in 3 of these there was necrosis of the pleura. In 2 an acute broncho-pneumonia was engrafted on to the tuberculous condition.

TABLE III.

I have also tabulated the condition of the pleuræ in 63 consecutive cases where, post mortem, definite lesions of the lung were found:

Tuberculous lungs—44.

Pleura, normal, - - - -	9	
Fibrinous exudate, - - -	4	
Adhesions, - - - - -	24	
Pus, - - - - - -	4	[pleura necrosed in 4]
Clear fluid, - - - - -	3	[pleura necrosed in 2]
Tuberculous pleura, - - -	15	

[Papapanagiotu, in 43 cases (post mortem) of pulmonary tuberculosis under the age of eighteen months, found evidences of pleurisy in 21:

Sero-fibrinous,	5
Mixed,	1
Purulent,	3
Dry,	12]

In 16 cases the pleura was tuberculous. [In one case the pleura was tuberculous, but not the lung.]

Pleura, normal otherwise,	1
Fibrinous exudate,	3
Adhesions,	8
Pus,	2
Clear fluid,	2

Acute pneumonia—2.

Pleura, normal,	1
Clear fluid,	1

Broncho-pneumonia—17.

Pleura, normal,	4
Fibrinous exudate,	6
Adhesions,	3
Pus,	3
Clear fluid (hæmorrhagic),	1

Table II. requires some comment. From what is shewn below, the mortality in empyema varies very considerably—as would be expected—with the pulmonary condition, and in simple uncomplicated cases is small. It is thus natural that one should find few simple cases in post-mortem records. Similarly one would expect to find more tuberculous cases in post-mortem records. [Netter gives 2·3 per cent. as the mortality in pneumococcus cases, and 25 per cent. in the other varieties. This, however, refers to adults.] Out of the 9 cases where tuberculosis of the lung was present, in 2 an acute broncho-pneumonia also obtained, and it seems probable that this had some causative influence on the pleural condition.

The relative frequency of pulmonary conditions in relation to the causation of empyemata cannot thus be fairly judged from this table, though perhaps the ratio may be more accurate with regard to the mortality. It is worth while noting that of the 7 cases associated with tuberculosis, (omitting the broncho-pneumonic cases,) 3 had necrosis of the visceral pleura, a fact agreeing with Coats' remarks on the frequency of the connection between necrosis of the pleura and acute pleurisy in pulmonary phthisis.

In Table III. empyema was present in 9·09 per cent. of the tuberculous lungs, and in 17·6 per cent. of the broncho-pneumonic cases.

It would appear from the foregoing that tuberculosis does not play a very prominent part in the causation of empyema in childhood, and that when it is an etiological factor, the primary condition is generally advanced, and this agrees with the clinical series [see below], where only 8 per cent. were tuberculous.

Papapanagiotu found only 3 cases of empyema among 54 cases of pleurisy in infants under 18 months of age; 2 were associated with pneumonia and with broncho-pneumonia. With regard to tuberculosis, pleural effusions, he says, are not met with very often, dry pleurisy being more frequent.

Age seems to have a distinct influence in the causation of empyema. The following table shews this very markedly, 32 out of 40 pleural effusions under the age of 5 years being purulent [Gee 53 out of 78 cases]. One must suppose that the resistance to the invasion of septic bacteria is slight in early life, and becomes greater later on.

TABLE IV.

Age—Under	2½	5	7½	10	12½ years.	Total.
Empyema, - -	14	18	12	4	2	50
Serous effusion, -	2	6	12	18	9	47
	16	24	24	22	11	97

Side of chest involved.—The empyemata were, in 31 cases, on the left side, and in 17 cases on the right. Of Seharlau's cases, 20 were left-sided and 35 right-sided; from these figures it appears that pleurisy is about equally common on the two sides [51–52]. One case was bilateral.

TABLE V.

In the following series of cases the records are mainly clinical. The cases were as a rule only seen late in the disease, and the early history obtainable was sometimes defective; but in 5 cases the effusion developed under observation, following an acute pneumonia in 4, and what was probably a tuberculous condition in the 5th. In the rest, the history of the case, the physical signs on admission, the course of the disease, and, in some cases, the result of post-mortem examination, formed the grounds for the classification adopted. This, however, is necessarily defective, as follows from the above remarks, and the "bronchitis" group, in particular, should perhaps have been placed elsewhere. As, however, the evidence of any pneumonic condition was absent in these cases, they have been placed by themselves, and serve in some way to emphasize the varieties of pulmonary conditions which are met with in association with empyemata.

Cases apparently primary—24.

RESULTS—	Dismissed well, - - - - -	15
	Dismissed improved, - - - -	7
	Dismissed worse, - - - - -	2
	Died, - - - - - - -	—

None died in hospital; but of the two cases dismissed worse, one was removed in a dying condition a few days after operation. The other patient had coughed up several ounces of pus on the day prior to admission; a rib was resected, but the cavity either already was, or became septic, and the child left hospital, after some three months' residence, with the wound unhealed and symptoms of lardaceous disease.

[Mortality, 8·3 per cent.]

Cases associated with acute pneumonia—8.

RESULTS—	Dismissed well, - - - - -	3
	Dismissed improved, - - - -	3
	Died, - - - - - - -	2

In one of these cases the pus discharged through the lung, and the child was dismissed improved, without any operation having been undertaken. In another a similar result was obtained after four ounces of pus had been removed by aspiration.

Of the fatal cases, one died a fortnight after operation from pericarditis and meningitis, the empyema being well; in the other case, loculated collections of pus were found in the pleural cavity after death.

[Mortality, 25 per cent.]

Cases associated with bronchitis—6.

RESULTS—	Dismissed well,	3
	Dismissed worse,	1
	Died,	2

The case, dismissed worse, was one whose empyema had probably originated seven months prior to admission. A rib was resected, but the cavity never closed, and six months later he contracted measles and died a fortnight afterwards. The urine latterly contained a considerable quantity of albumen.

Of the fatal cases, one died suddenly in the morning before operation, and in the other severe diarrhœa set in, and acute orchitis and parotitis preceded death.

[Mortality, 50 per cent.]

Cases associated with broncho-pneumonia—7.

RESULTS—	Dismissed well,	1
	Died,	6

Of the fatal cases, in 4 loculated collections of pus were found in the pleural cavity after death, one had an acute nephritis, and died three days after operation, and in the other multiple abscesses were found in the lungs. In the case which recovered, only a small quantity of pus was removed by aspiration.

[Mortality, 87·5 per cent.]

Cases associated with tuberculosis—4.

RESULTS—	Dismissed worse,	1
	Died,	3

The case dismissed worse was a broncho-pneumonic one, which was considered to be tuberculous in character. Two of the other cases had pyopneumothorax. [In one of these (aet. 2), as no microscopic examination was made, the diagnosis of tuberculosis must be questioned. It is included under tuberculosis, however, as I did not wish to exclude any, even questionable cases, from this class.]

Case associated with pericarditis—1.

RESULT—Dismissed improved.

It was impossible in this case to say which was the primary lesion. The pleural condition on dismissal was good, but the heart had shewed signs of failure.

It is evident from the above tables that the causation of empyemata has much to do with the ultimate result, the primary empyemata and those associated with acute pneumonia, having a small mortality as compared with those complicating broncho-pneumonia or tuberculosis.

TABLE VI.

COMPLICATIONS.—In 20 of these 50 cases some complication occurred, and in several more than one.

Pericarditis was noted in 8 cases, and recovery ensued in 3, though in 1 of these, signs of cardiac failure occurred. Of these 8 cases, 4 had left-sided effusions, and 4 right-sided effusions.

Endocarditis occurred once: recovery.

Acute meningitis was noted twice, both cases ending fatally; but both were otherwise complicated, one by pericarditis, and the other by a tuberculous cavity in the lung.

Acute peritonitis occurred in one of the pericarditis cases: death.

Acute otitis media occurred in one of the nephritis cases: dismissed improved.

Acute adenitis [testis, parotid, submaxillary glands] occurred once: death.

Albuminuria was noted in 4 cases. In 3 it was transient. In the other a renal condition was known to have obtained for some time, and the child was dismissed worse.

Nephritis occurred twice. One case was dismissed improved.

Rupture into the lung occurred 4 times. In 3 of these cases a rib was resected, and in 2 recovery ensued. In the other the wound became septic, and the child was dismissed worse. The fourth case is worthy of note: Wm. E., aet. $5\frac{8}{12}$ years, took pneumonia on Nov. 15, 1893, and the crisis occurred on the 22nd. On Nov. 29 signs of pleurisy were present, and on Dec. 16 he suddenly began to spit up purulent material in some quantity, and signs of pneumothorax were apparent. No Tubercle bacilli were found on examination of the sputum. An exploratory puncture shewed the presence of pus in the pleural cavity, but nothing in the way of operative interference was undertaken. He was dismissed on Feb. 15, 1894, in good health, but with some impairment of the extreme base of the lung.

TABLE VII.

FATAL CASES. *Results of post-mortem examination.*

There were 11 post-mortems out of the 14 fatal cases recorded above.

SIMPLE—		
Sudden death before operation,		1
Pneumonia—Double loculated empyema,		1
TUBERCULOUS—		
Pyopneumothorax [see note above],		2
SEPTIC—		
Pericarditis,		5
Also in addition		
Meningitis,	1	
Peritonitis,	1	
Multiple abscesses in lung,	1	
Multiple abscesses in lung,		1
Orchitis, parotitis, etc.,		1

Excluding the tuberculous cases, in 7 out of the 9 cases multiple septic foci were found at death. The empyemata associated with broncho-pneumonia seem particularly liable to sepsis, as this occurred in 5 out of the 6 fatal cases. (In the other there was no post-mortem examination). This is probably related to the fact that, with broncho-pneumonia, various organisms are associated [the diplococcus, B. influenza, streptococcus, staphylococcus, etc.], and the infection is often mixed.

A large number of cases of empyema end fatally. Taking all the cases recorded above, and including the "dismissed worse" cases in the death list, the total mortality was 34 per cent. In the operation cases the mortality was 25 per cent.

Scharlau, in a series of 56 cases operated upon, had a mortality of 33 per cent.

It is evident from what has gone before that the immediate prognosis of an empyema in childhood is dependent on a variety of conditions other than the physical condition of the patient at the time. What perhaps affects the prognosis to the greatest extent is an early diagnosis. A simple empyema diagnosed early, and promptly operated on usually terminates favourably, and in several of the above cases the drainage tube was removed on the fourth day, and the wound healed by the tenth. Early and free drainage has two effects: it prevents the continued absorption of septic material and it removes a possible source of septic infection of other organs, a condition which is by far the most frequent immediate cause of death.

With regard to diagnosis, one point especially has appealed to me—the value of the sense of increased resistance felt on percussion over pleural effusions. This is of special value in these cases, as the vocal phenomena on which one relies so largely in adult cases are, as a rule, inapplicable in children, and the auscultatory signs are often misleading. The only other point is the necessity for exploratory puncture in all doubtful cases of pulmonary disease—a necessity which is self-evident after one has found an empyema, which had been unrecognized during life, on the post-mortem table. The dangers of puncture are practically nil, and the result of maldiagnosis is almost invariably the death of the patient.

When recognized, an empyema should be promptly dealt with. One case of sudden death before operation is recorded above (left-sided empyema). Death in such cases is probably due to syncope, and the risk is not always in proportion to the amount of the effusion or the degree of cardiac displacement. In large effusions a considerable amount of fluid should always be drawn off at once for this reason alone, though there can be little doubt that the resection of a rib is less dangerous, if the pleural cavity contains little fluid than if it be full. Syphonage without aspiration is gradual, and permits of slow reposition of displaced organs, therein differing from the sudden evacuation and rapid reposition at operation. Death on the operating table is almost always associated with sudden evacuation of a large quantity of fluid, generally with the patient turned on to the sound side.

In all these cases which were operated upon, resection of a rib was done.[1] Osler suggests that in the pneumococcic cases this is not always necessary, aspiration or simple incision being sufficient, though in the streptococcic cases free drainage is required. One would be unwilling to resect a rib if the condition depended on a tuberculous pneumothorax.

The difficulties of diagnosis are particularly great in cases of loculated empyemata, and here the exploring needle is especially needful, as also that the surgeon should cut down at the point where pus has been found, and not at a site of election.

As an example of the evil results of pus remaining in the pleural cavity for a long time, the following case is recorded :

Richard C. (æt. 4) had an attack of "meningitis" in March, 1888, but "recovered" in a fortnight. His side was blistered at this time by the doctor's orders. He never got quite well, and a fortnight before admission caught cold and became very ill. He was admitted into hospital on Oct. 22, and a rib was resected and the pleural cavity drained. The lung, however, failed to expand, and pus continued to discharge from the wound. In April, 1889, he contracted measles and was sent to Belvidere, where he died a fortnight later. There was latterly a considerable amount of albumen in the urine. No post mortem was obtained. In this case there seems but little doubt that the empyema dated from March, 1888, and that the lung failed to expand after seven months' compression.

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[1] In one case an attempt was made to avoid thoracotomy by aspiration. This case occurred under circumstances which rendered it improbable that asepsis could be obtained.

Alec G. (æt. 9) took ill on Sept. 28th, and had to take to bed next day. On Oct. 3rd there was evidence of consolidation at the right base, and on Oct. 4th he complained a good deal of pain in the chest. On the 15th the urine was scanty, bloody, and highly albuminous, and on the 18th there was evidence of effusion into the right pleural sac. On Oct. 19th his right ear commenced to discharge. On Oct. 20th 4 oz. of pus were removed by aspiration from the right pleural cavity. The fluid never reaccumulated, and on dismissal on Dec. 31st he was in excellent health ; the base of the lung had, however, not completely resolved, and slight albuminuria still persisted.

Age has a distinct influence on the result. The younger the patient the greater the danger, though in one case recorded above, a child of 11 months, recovery ensued on resection of a rib. The difficulty of diagnosis in young children, their greater susceptibility to septic infection, and their small vitality are all causal to this, though, on the other hand, the sudden rebound to health, when the cause of the illness is removed, is often very striking.

The previous health of the patient, while probably causal to some extent, naturally affects the prognosis, the results in debilitated subjects being much more unfavourable than in those in good condition at the time of operation.

With regard to the pulmonary condition obtaining, it would seem that tuberculosis is only to a small extent associated with empyema in early life [8 per cent. in these cases. Netter gives the ratio as 14 per cent. In Scharlau's cases two died from tuberculosis; eight died from pneumonia, "probably on a tuberculous basis"; but he gives no post-mortem results]. When so associated the tuberculous condition is usually advanced, and the prognosis is very grave. Empyema occurring in a healthy child, and either primary or associated with pneumonia, is a disease with a small mortality; but when associated with broncho-pneumonia the prognosis is very serious—facts probably correlated to the bacterial results quoted above. [See note, p. 316.]

Still has pointed out that in empyema in children, death is very frequently the result of secondary septic infection, and in the table given above seven out of nine cases shewed other septic foci. [Still, 20 in 28 fatal cases.] Secondary infections, however, though adding greatly to the danger of the case, are by no means necessarily fatal, as three cases covered, though complicated by pericarditis, one complicated by endocarditis and one by otitis media. In the majority, however, death results. Meningitis will probably be always fatal. Nephritis is not necessarily fatal, and transient albuminuria seems to add little to the danger.

The pus may discharge through the lung, and recovery ensue without operation. It is interesting to note that in only one of the three cases operated upon after this had occurred, did sepsis of the pleural cavity ensue.

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